What is Claimed Is:

1. A method of automatically classifying a defect on the surface of an article, which method comprises at least:

imaging the surface; and

classifying the defect as being in one of a predetermined number of invariant core classes of defects.

2. The method according to claim 1, wherein the core classes of defects comprise a missing pattern on the surface, an extra pattern on the surface, a particle on the surface, a particle embedded in the surface, and microscratches on the surface.

3. The method according to claim 1, comprising imaging the surface with a scanning electron microscope.

4. The method according to claim 1, comprising:

classifying a plurality of defects on the surface of the article; and

determining a total number of defects in each of the core classes.

5. The method according to claim 4, comprising generating an alarm signal when the total number of defects in a specific one of the core classes is equal to or greater than a first predetermined number.

6. The method according to claim 1, comprising further classifying the defect as being in one of an arbitrary number of variant subclasses.

7. The method according to claim 6, comprising:

classifying a plurality of defects on the surface of the article; and

determining a total number of defects in each of the subclasses.

8. The method according to claim 7, comprising generating an alarm signal when the total number of defects in a specific one of the subclasses is about equal to or greater than a second predetermined number.

9. A method of inspecting a defect on the surface of an article, which method comprises:

acquiring an image of the defect;

obtaining a reference image;

comparing the defect image and the reference image to produce an estimated defect footprint;

obtaining a magnified defect image;

obtaining a magnified reference image; and

comparing the estimated defect footprint, the magnified defect image and the magnified reference image to produce a defect footprint.

10. The method according to claim 9, wherein the article has a plurality of comparable pattern units, the defect is located in a first one of the pattern units, and wherein the step of obtaining a reference image includes acquiring an image of a second, non-defective one of the pattern units.

11. The method according to claim 9, further comprising magnifying the reference image using a machine-implemented algorithm.

12. The method according to claim 10, wherein the article is a semiconductor wafer, and the pattern units are substantially identical integrated circuit dies.

13. The method according to claim 9, wherein the steps of acquiring the defect image and obtaining the reference image include collecting electrons from a plurality of angular sectors.

14. The method according to claim 10, further comprising:

finding the defect prior to review by determining a suspected location on the first pattern unit having a high probability of a defect and comparing the suspected location to an unsuspected location on another of the pattern units; and

performing a boundary analysis of the defect footprint to classify the defect.

15. The method according to claim 14, further comprising determining reference segmentation by:

identifying portions of the magnified reference image which correspond to a reference pattern; and

identifying portions of the magnified reference image which correspond to a background to the reference pattern.

16. The method according to claim 15, wherein the boundary analysis comprises:

identifying common boundaries existing in both the defect footprint and the magnified reference image;

identifying a defect boundary of the defect footprint which does not exist in the magnified reference image; and

identifying a boundary of the magnified reference image which does not exist in the defect footprint, if such a boundary is present.

17. The method according to claim 16, further comprising determining the flatness of the defect from the signal produced by an angular detector.

18. A computer-readable medium bearing instructions for automatically classifying a defect on the surface of an article, said instructions, when executed, being arranged to cause one or more processors to perform the steps of:

imaging the surface; and

classifying the defect as being in one of a predetermined number of invariant core classes of defects.

19. The computer-readable medium according to claim 18, wherein the core classes of defects comprise a missing pattern on the surface, an extra pattern on the surface, and a particle on the surface.

20. The computer-readable medium according to claim 18, wherein the instructions, when executed, are arranged to cause the one or more processors to perform the step of imaging the surface with a scanning electron microscope.

21. The computer-readable medium according to claim 18, wherein the instructions, when executed, are arranged to cause the one or more processors to perform the steps of:

classifying a plurality of defects on the surface of the article; and

determining a total number of defects in each of the core classes.

22. The computer-readable medium according to claim 21, wherein the instructions, when executed, are arranged to cause the one or more processors to perform the step of generating an alarm signal when the total number of defects in a specific one of the core classes is about equal to or greater than a first predetermined number.

23. The computer-readable medium according to claim 18, wherein the instructions, when executed, are arranged to cause the one or more processors to perform the step of classifying the defect as being in one of an arbitrary number of subclasses of arbitrarily defined defects.

24. The computer-readable medium according to claim 23, wherein the instructions, when executed, are arranged to cause the one or more processors to perform the steps of:

classifying a plurality of defects on the surface of the article; and

determining a total number of defects in each of the subclasses.

25. The computer-readable medium according to claim 24, wherein the instructions, when executed, are arranged to cause the one or more processors to perform the step of generating an alarm signal when the total number of defects in a specific one of the subclasses is about equal to or greater than a second predetermined number.

26. A computer-readable medium bearing instructions for inspecting a defect on the surface of an article, said instructions, when executed, being arranged to cause one or more processors to perform the steps of:

receiving an image of the defect;

obtaining a reference image;

comparing the defect image and the reference image to produce an estimated defect footprint;

obtaining a magnified defect image;

obtaining a magnified reference image; and

comparing the estimated defect footprint, the magnified defect image and the magnified reference image to produce a defect footprint.

27. The computer-readable medium according to claim 26, wherein the article has a plurality of comparable pattern units, the defect is located in a first one of the pattern units, and the step of obtaining a reference image includes obtaining an image of a second, non-defective one of the pattern units.

28. The computer-readable medium according to claim 26, wherein the instructions, when executed, are arranged to cause the one or more processors to perform the step of magnifying the reference image using a machine-implemented algorithm.

29. The computer-readable medium according to claim 27, wherein the article is a semiconductor wafer, and the pattern units are substantially identical integrated circuit dies.

30. The computer-readable medium according to claim 26, wherein the instructions, when executed, are arranged to cause the one or more processors to perform the steps of receiving the defect image and obtaining the reference image from a scanning electron microscope which collects electrons emitted from a plurality of angular sectors.

31. The computer-readable medium according to claim 26, wherein the instructions, when executed, are arranged to cause the one or more processors to perform the steps of:

finding the defect prior to inspection by determining a suspected location on the first pattern unit having a high probability of a defect and comparing the suspected location to an unsuspected location on another of the pattern units; and

performing a boundary analysis of the defect footprint to classify the defect.

32. The computer-readable medium according to claim 31, wherein the instructions, when executed, are arranged to cause the one or more processors to perform the step of determining reference segmentation by:

identifying portions of the magnified reference image which correspond to a reference pattern; and

identifying portions of the magnified reference image which correspond to a background to the reference pattern.

33. The computer-readable medium according to claim 32, wherein the boundary analysis comprises:

identifying common boundaries existing in both the defect footprint and the magnified reference image;

identifying a defect boundary of the defect footprint which does not exist in the magnified reference image; and

identifying a boundary of the magnified reference image which does not exist in the defect footprint, if such a boundary is present.

34. The computer-readable medium according to claim 33, wherein the flatness of the defect is determined by the instructions, when executed, being arranged to cause the one or more processors to receive flatness information from a scanning electron microscope.

35. The computer-readable medium according to claim 18, wherein the instructions, when executed, are arranged to cause the one or more processors to perform the step of imaging by acquiring a plurality of images using a plurality of spaced-apart detectors.

36. The computer-readable medium according to claim 35, wherein the instructions, when executed, are arranged to cause the one or more processors to acquire the images by causing the detectors to collect electrons.

37. An apparatus for classifying a defect on the surface of an article, comprising:

an imager to produce an image of the defect and a reference image;

a storage device to store the defect image and the reference image;

a comparator to compare the defect image and the reference image; and

a processor to classify the defect as being in one of a predetermined number of invariant core classes of defects.

38. The apparatus of claim 37, wherein the imager is a scanning electron microscope (SEM).

39. The apparatus of claim 37, further comprising a first counter for counting the number of defects in each of the core classes and a first signal generator for generating an alarm signal when the total number of defects in a specific one of the core classes is about equal to or greater than a first predetermined number.

40. The apparatus of claim 37, wherein the storage device is a digital storage device.

41. The apparatus of claim 37, further comprising a processor for classifying the defect as being in one of an arbitrary number of subclasses of arbitrarily defined defects.

42. The apparatus of claim 41, further comprising a second counter for counting the number of defects in each of the subclasses and a second signal generator for generating an alarm signal when the total number of defects in a specific one of the subclasses is about equal to or greater than a second predetermined number.

43. The apparatus of claim 38, further comprising a plurality of spaced-apart detectors and a monitor to display images produced by the plurality of detectors.

44. The apparatus of claim 38, wherein the SEM comprises an SEM column, wherein a first one of the plurality of detectors is disposed inside the SEM column and a second one of the plurality of detectors is disposed outside the SEM column.

45. The apparatus of claim 44, further comprising a first monitor for displaying an image produced by the first detector, and a second monitor for displaying an image produced by the second detector.

46. A method of automatically classifying a defect on the surface of an article, which method comprises:

imaging the surface with a scanning electron microscope and an optical imager; and

classifying the defect as being in one of a predetermined number of classes of defects.

47. The method according to claim 46, wherein the classes of defects include the color of the surface.

48. The method according to claim 46, wherein the surface is glass, and the classes of defects include a particle embedded in the surface and substantially not protruding from the surface.

49. A method of inspecting a defect on the surface of an article, which method comprises:

acquiring a picture of the defect;

obtaining a reference picture; and

performing a boundary analysis of the defect picture to classify the defect, the boundary analysis comprising:

identifying common boundaries existing in both the defect picture and the reference picture;

identifying a defect boundary of the defect picture which does not exist in the reference picture; and

identifying a boundary of the reference picture which does not exist in the defect picture, if such a boundary is present.

50. The method according to claim 49, further comprising determining reference segmentation by:

identifying portions of the reference picture which correspond to a reference pattern; and

identifying portions of the reference picture which correspond to a background to the reference pattern.

51. The method according to claim 49, wherein the article has a plurality of comparable pattern units, the defect is located in a first one of the pattern units, and wherein the step of obtaining a reference picture includes acquiring an image of a second, non-defective one of the pattern units.

52. The method according to claim 51, wherein the article is a semiconductor wafer, and the pattern units are substantially identical integrated circuit dies.

53. The method according to claim 51, further comprising finding the defect by determining a suspected location on the first pattern unit having a high probability of a defect and comparing the suspected location to an unsuspected location on another of the pattern units.

54. The method according to claim 49, further comprising determining flatness of the defect from the signal produced by an angular detector.

55. A computer-readable medium bearing instructions for inspecting a defect on the surface of an article, said instructions, when executed, being arranged to cause one or more processors to perform the steps of:

receiving a picture of the defect;

obtaining a reference picture; and

performing a boundary analysis of the defect picture to classify the defect, the boundary analysis comprising:

identifying common boundaries existing in both the defect picture and the reference picture;

identifying a defect boundary of the defect picture which does not exist in the reference picture; and

identifying a boundary of the reference picture which does not exist in the defect picture, if such a boundary is present.

56. The computer-readable medium according to claim 55, wherein the instructions, when executed, are arranged to cause the one or more processors to perform the step of determining reference segmentation by:

identifying portions of the reference picture which correspond to a reference pattern; and

identifying portions of the reference picture which correspond to a background to the reference pattern.

57. The computer-readable medium according to claim 55, wherein the article has a plurality of comparable pattern units, the defect is located in a first one of the pattern units, and the step of obtaining a reference picture includes obtaining an image of a second, non-defective one of the pattern units.

58. The computer-readable medium according to claim 57, wherein the article is a semiconductor wafer, and the pattern units are substantially identical integrated circuit dies.

59. The computer-readable medium according to claim 57, wherein the instructions, when executed, are arranged to cause the one or more processors to perform the steps of:

finding the defect by determining a suspected location on the first pattern unit having a high probability of a defect and comparing the suspected location to an unsuspected location on another of the pattern units.

60. The computer-readable medium according to claim 55, wherein the flatness of the defect is determined by the instructions, when executed, being arranged to cause the one or more processors to receive flatness information from a scanning electron microscope.

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